

AMENDMENTS TO THE CLAIMS

- 1    1. (Currently amended) A network device-based method comprising:  
2        sending a plurality of packets;  
3        receiving a plurality of acknowledgements, wherein each of the plurality of  
4        acknowledgements acknowledges receipt of at least one of the plurality of  
5        packets, wherein the plurality of acknowledgements includes at least one  
6        duplicate acknowledgement containing no more information than is contained in a  
7        previously received one of the plurality of acknowledgements;  
8        determining and retaining, upon receiving acknowledgement of receipt of new datathe  
9        plurality of acknowledgements, an excess number of duplicate  
10      acknowledgements, by at least determining a number representing how many  
11      additional packets were co-acknowledged with the duplicate acknowledgements;  
12      wherein the excess number of duplicate acknowledgements is a number that represents an  
13      amount of duplicate acknowledgements and is determined based upon a  
14      difference between a count of consecutive duplicate acknowledgement packets  
15      and the number of co-acknowledged packets; and  
16      taking a network packet transmission recovery action based upon said excess number of  
17      duplicate acknowledgements.
- 1    2. (Previously presented) The network device-based method of Claim 1 further comprising:  
2        determining whether a congestion window is inflated prior to deciding whether to  
3        determine said excess number of duplicate acknowledgements.
- 4    3. (Original) The network device-based method of Claim 1 wherein a value of the excess  
5        number of duplicate acknowledgements is a count of bytes in the duplicate  
6        acknowledgements used to determine the excess number of duplicate acknowledgements  
7        and wherein said taking a network packet transmission recovery action further comprises:  
8        deflating a congestion window upon said value being less than a number of bytes in a  
9        transmission control protocol sender segment.

1    4. (Original) The network device-based method of Claim 1 wherein said taking a network  
2    packet transmission recovery action further comprises:  
3       optimizing a size of a congestion window to match a reduction in a quantity of  
4       unacknowledged data upon said excess number of duplicate acknowledgements  
5       being greater than a TCP sender segment.

1    5. (Original) The network device-based method of Claim 1 wherein said taking a network  
2    packet transmission recovery action further comprises:  
3       comparing said excess number of duplicate acknowledgements with a duplicate  
4       acknowledgement threshold.

1    6. (Original) The network device-based method of Claim 5 wherein said taking a network  
2    packet transmission recovery action further comprises:  
3       performing a fast retransmit upon said comparing said excess number of duplicate  
4       acknowledgements with a duplicate acknowledgement threshold indicating that  
5       said excess number of duplicate acknowledgements is greater than or equal to said  
6       duplicate acknowledgement threshold.

1    7. (Original) The network device-based method of Claim 6, wherein said taking a network  
2    packet transmission recovery action further comprises:  
3       analyzing a size of a congestion window.

1    8. (Original) The network device-based method of Claim 7, wherein said taking a network  
2    packet transmission recovery action further comprises:  
3       resizing said congestion window upon said analyzing said size of said congestion window  
4       showing said size is greater than a predefined size.

1    9. (Original) The network device-based method of Claim 5, wherein said taking a network  
2    packet transmission recovery action further comprises:

3         analyzing a size of a congestion window upon said comparing said excess number of  
4         duplicate acknowledgements with a duplicate acknowledgement threshold  
5         indicating that said excess number of duplicate acknowledgements is less than  
6         said duplicate acknowledgement threshold.

1    10. (Original) The network device-based method of Claim 9, wherein said taking a network  
2    packet transmission recovery action further comprises:

3         resizing said congestion window upon said analyzing said size of said congestion window  
4         showing said size is greater than a predefined size.

1    11. (Original) The network device-based method of Claim 1 wherein said method is included  
2    in Transmission Control Protocol congestion avoidance.

1    12. (Currently amended) A network device-based method comprising:  
2         receiving a plurality of acknowledgements, wherein each of the plurality of  
3         acknowledgements acknowledges receipt of at least one of the plurality of  
4         packets;  
5         wherein the plurality of acknowledgements includes at least one duplicate  
6         acknowledgement, which is an acknowledgement containing no more information  
7         than is contained in a previously received acknowledgement of one of the  
8         plurality of acknowledgements;  
9         determining and retaining, upon receiving ~~acknowledgement of receipt of new data~~the  
10      plurality of acknowledgements, an excess number of duplicate  
11      acknowledgements, by at least determining a number representing how many  
12      additional packets were acknowledged with the duplicate acknowledgements,  
13      which are thereby co-acknowledged packets;

14 wherein the excess number of duplicate acknowledgements is a number that ~~represents an~~  
15 ~~amount of duplicate acknowledgements and is determined based upon a~~  
16 ~~difference between a count of consecutive duplicate acknowledgement packets~~  
17 ~~and the number of co-acknowledged packets; and~~  
18 deflating a congestion window upon said value of said excess number of duplicate  
19 acknowledgements being less than a transmission control protocol sender  
20 segment; and  
21 optimizing a size of said congestion window to match a reduction in a quantity of  
22 unacknowledged data upon said excess number of duplicate acknowledgements  
23 being greater than a transmission control protocol sender segment.

1 13. (Original) The network device-based method of Claim 12 wherein a value of the excess  
2 number of duplicate acknowledgements is a count of bytes in the duplicate  
3 acknowledgements used to determine the excess number of duplicate acknowledgements  
4 and further comprising:  
5 comparing said excess number of duplicate acknowledgements with a duplicate  
6 acknowledgement threshold upon said excess number of duplicate  
7 acknowledgements being greater than a number of bytes in a TCP sender  
8 segment.

1 14. (Original) The network device-based method of Claim 13 further comprising:  
2 performing a fast transmit upon said comparing said excess number of duplicate  
3 acknowledgements with a duplicate acknowledgement threshold indicating that  
4 said excess number of duplicate acknowledgements is greater than or equal to said  
5 duplicate acknowledgement threshold.

1 15. (Original) The network device-based method of Claim 14 further comprising:  
2 analyzing a size of said congestion window.

- 1    16. (Original) The network device-based method of Claim 15 further comprising:  
2        resizing said congestion window upon said analyzing said size of said congestion window  
3        showing said size is greater than a predefined size.
  
- 1    17. (Original) The network device-based method of Claim 12 further comprising:  
2        analyzing a size of said congestion window upon said comparing said excess number of  
3              duplicate acknowledgements with a duplicate acknowledgement threshold  
4              indicating that said excess number of duplicate acknowledgements is less than  
5              said duplicate acknowledgement threshold.
  
- 1    18. (Original) The network device-based method of Claim 17 further comprising:  
2        resizing said congestion window upon said analyzing said size of said congestion window  
3        showing said size is greater than a predefined size.
  
- 1    19. (Original) The network device-based method of Claim 12 wherein said method is  
2        included in Transmission Control Protocol congestion avoidance.
  
- 1    20. Cancelled.
  
- 1    21. (Currently amended) A network device comprising:  
2        a processor; and  
3        a memory coupled to said processor, and storing a fast recovery extended method  
4        wherein upon execution of said fast recovery extended method by said processor, causes  
5        said network device to:  
6              send a plurality of packets;

7           receive a plurality of acknowledgements, wherein each of the plurality of  
8           acknowledgements acknowledges receipt of at least one of the plurality of  
9           packets;  
10          wherein the plurality of acknowledgements includes at least one duplicate  
11          acknowledgement, which is an acknowledgement containing no more  
12          information than is contained in a previously received acknowledgement  
13          of one of the plurality of acknowledgements;  
14          determine, upon receiving acknowledgement of receipt of the plurality of  
15          acknowledgements~~new data~~, an excess number of duplicate  
16          acknowledgements, by at least determining a number representing how  
17          many additional packets were acknowledged with the duplicate  
18          acknowledgements, which are thereby co-acknowledged packets;  
19          wherein the excess number of duplicate acknowledgements is a number that is  
20          determined ~~represents an amount of duplicate acknowledgements and is~~  
21          based upon a difference between a count of consecutive duplicate  
22          acknowledgement packets and the number of co-acknowledged packets;  
23          retain said excess number of duplicate acknowledgements in said memory; and  
24          take a network packet transmission recovery action based upon said excess  
25          number of duplicate acknowledgements.

1      22.     (Canceled)

1      23.     (Previously presented) The network device of Claim 21, wherein said fast recovery  
2           extended method further comprises:  
3           determining whether a congestion window is inflated prior to deciding whether to  
4           determine said excess number of duplicate acknowledgements.

1      24.     (Previously presented) The network device of Claim 21, wherein a value of the excess  
2           number of duplicate acknowledgements is a count of bytes in the duplicate

3 acknowledgements used to determine the excess number of duplicate acknowledgements  
4 and wherein said taking a network packet transmission recovery action further comprises:  
5 deflating a congestion window upon said value of said excess number of duplicate  
6 acknowledgements being less than a number of bytes in a transmission control  
7 protocol sender segment.

1 25. (Previously amended) The network device of Claim 21, wherein said taking a network  
2 packet transmission recovery action further comprises:  
3 optimizing a size of a congestion window to match a reduction in a quantity of  
4 unacknowledged data upon said excess number of duplicate acknowledgements  
5 being greater than a TCP sender segment.

1 26. (Previously presented) The network device of Claim 21, wherein said taking a network  
2 packet transmission recovery action further comprises:  
3 comparing said excess number of duplicate acknowledgements with a duplicate  
4 acknowledgement threshold.

1 27. (Original) The network device of Claim 26 wherein said taking a network packet  
2 transmission recovery action further comprises:  
3 performing a fast retransmit upon said comparing said excess number of duplicate  
4 acknowledgements with a duplicate acknowledgement threshold indicating that  
5 said excess number of duplicate acknowledgements is greater than or equal to said  
6 duplicate acknowledgement threshold.

1 28. (Original) The network device of Claim 27, wherein said taking a network packet  
2 transmission recovery action further comprises:  
3 analyzing a size of a congestion window.

- 1 29. (Original) The network device of Claim 28, wherein said taking a network packet  
2 transmission recovery action further comprises:  
3 resizing said congestion window upon said analyzing said size of said congestion window  
4 showing said size is greater than a predefined size.
- 1 30. (Original) The network device of Claim 26, wherein said taking a network packet  
2 transmission recovery action further comprises:  
3 analyzing a size of a congestion window upon said comparing said excess number of  
4 duplicate acknowledgements with a duplicate acknowledgement threshold  
5 indicating that said excess number of duplicate acknowledgements is less than  
6 said duplicate acknowledgement threshold.
- 1 31. (Original) The network device of Claim 30, wherein said taking a network packet  
2 transmission recovery action further comprises:  
3 resizing said congestion window upon said analyzing said size of said congestion window  
4 showing said size is greater than a predefined size.
- 1 32. (Previously presented) The network device of Claim 21, wherein said method is included  
2 in Transmission Control Protocol congestion avoidance.
- 1 33. (Currently amended) A programmable memory including a fast recovery extended  
2 method wherein said fast recovery extended method upon execution comprises:  
3 sending a plurality of packets;  
4 receiving a plurality of acknowledgements, wherein each of the plurality of  
5 acknowledgements acknowledges receipt of at least one of the plurality of  
6 packets;  
7 wherein the plurality of acknowledgements includes at least one duplicate  
8 acknowledgement, which is an acknowledgement containing no more information

9           than is contained in a previously received acknowledgement of one of the  
10          plurality of acknowledgements;  
11          determining and retaining, upon receiving acknowledgement of receipt of new data the  
12          plurality of acknowledgements, an excess number of duplicate  
13          acknowledgements, by at least determining a number representing how many  
14          additional packets were acknowledged with the duplicate acknowledgements,  
15          which are thereby co-acknowledged packets;  
16          wherein the excess number of duplicate acknowledgements is a number that is  
17          determined represents an amount of duplicate acknowledgements and is based  
18          upon a difference between a count of consecutive duplicate acknowledgement  
19          packets and the number of co-acknowledged packets; and  
20          taking a network packet transmission recovery action based upon said excess number of  
21          duplicate acknowledgements.

1       34.      Cancelled.

1       35.      (Currently amended) A network device comprising:  
2          means for sending a plurality of packets;  
3          means for receiving a plurality of acknowledgements, wherein each of the plurality of  
4          acknowledgements acknowledges receipt of at least one of the plurality of  
5          packets;  
6          wherein the plurality of acknowledgements includes at least one duplicate  
7          acknowledgement, which is an acknowledgement containing no more information  
8          than is contained in a previously received acknowledgement of one of the  
9          plurality of acknowledgements;  
10         means for determining, upon receiving acknowledgement of receipt of new data the  
11          plurality of acknowledgements, an excess number of duplicate  
12          acknowledgements,

13 by at least determining a number representing how many additional packets were  
14 acknowledged with the duplicate acknowledgements, which are thereby co-  
15 acknowledged packets;  
16 wherein the excess number of duplicate acknowledgements is a number that represents an  
17 amount of duplicate acknowledgements and is determined based upon a  
18 difference between a count of consecutive duplicate acknowledgement packets  
19 and the number of co-acknowledged packets; and  
20 means for retaining said excess number of duplicate acknowledgements; and  
21 means for taking a network packet transmission recovery action based upon said excess  
22 number of duplicate acknowledgements.

1 36. (Previously presented) A method for recovery of multiple transmission units comprising:  
2 transmitting a plurality of transmission units from a sender to a receiver,  
3 wherein the receiver is an entity that is currently receiving transmission units, and  
4 wherein the sender is an entity that is currently sending the transmission units;  
5 the receiver transmitting acknowledgements of receipt of the transmission units received;  
6 setting a duplicate acknowledgements threshold, wherein a duplicate acknowledgement is  
7 an acknowledgement of receipt of a transmission unit for which an  
8 acknowledgement already exists;  
9 setting a size for a congestion window;  
10 determining a value representing a count of consecutive duplicate acknowledgements;  
11 if the value is equal to the duplicate acknowledgement threshold,  
12 performing a first fast retransmit operation in which at least one of the  
13 transmission units is retransmitted, and  
14 resizing the size of the congestion window;  
15 determining whether any subsequent duplicate acknowledgements were received;  
16 in response to receipt of each of the subsequent duplicate acknowledgements,  
17 increasing the size of the congestion window, and  
18 if transmitting another segment is permitted, transmitting another segment; and  
19 when an acknowledgement for the transmission unit that was retransmitted is received,  
20 performing a fast recovery including at least  
21 a get excess operation which at least

22       determines a value representing an excess number of duplicate acknowledgements  
23       by at least determining a number representing how many additional  
24       packets were acknowledged with the duplicate acknowledgements, which  
25       are thereby co-acknowledged packets;  
26               wherein the excess number of duplicate acknowledgements is a  
27               number that is determined based upon a difference between  
28               the value of the count of consecutive duplicate  
29               acknowledgements for the retransmitted transmission units  
30               and the number of co-acknowledged packets;,,  
31       a recovery action operation, in which at least the sender initiates one or  
32       more network packet transmission recovery actions based upon the  
33       excess duplicate acknowledgements, wherein the network packet  
34       transmission recovery actions include at least  
35               taking no further action,  
36               deflating the size of the congestion window,  
37               resizing the size of the congestion window to a more  
38               optimal size,  
39               performing another fast retransmit,  
40               resizing the size of the congestion window from the more  
41               optimal size, and  
42               resizing the size congestion window after the deflating, and  
43       a set duplicate acknowledgment operation in which at least the value  
44       representing the count of the duplicate acknowledgements is set  
45       equal to the value representing the excess duplicate  
46       acknowledgements.

- 1       37. (New) A method according to claim 1, wherein the taking of the network packet  
2       transmission recovery action based on the excess number of duplicate acknowledgements  
3       includes at least:  
4       determining based on the excess number of duplicate acknowledgements whether the number of  
5       duplicate acknowledgements is equal to or less than the number of co-acknowledged  
6       segments;

- 7      if the number of duplicate acknowledgements is equal to or less than the number of co-
- 8                 acknowledged segments determining the network packet transmission recovery action
- 9                 based on the number of duplicate acknowledgements; and
- 10     if the number of duplicate acknowledgements is not equal to or less than the number of co-
- 11                 acknowledged segments determining the network packet transmission recovery action
- 12                 based on the excess number of duplicate acknowledgements.